

Applicant(s): Eitan Bachmat, Tao Kai Lam and Ruben Michel
Serial No.: 09/541,159
Filed: March 31, 2000

E30-043 (99-202)

as
example, the order of the logical volumes in FIG. 3 would be LV1, LV2, LV3. In this particular case the sequence of names corresponds to the order, but the logical volume names and the sequence with which they appear are arbitrary. --

In the Claims

Please amend claims 6, 10, 23 through 25, 27 and 28 as follows:

as
6 (Amended). A method as recited in claim 5 wherein said linear interpolation is based upon a Ratio Theorem analysis.

10 (Amended). A method as recited in claim 9 wherein said segment seek time determination includes the step of:

- as
i) assigning a predetermined seek time for each seek operation between two segment boundaries, and
ii) calculating an intrasegment seek time based upon the predetermined seek times.
-

as
23 (Amended). A method for determining the seek time over a time interval for a physical disk drive configured to

Applicant(s): Eitan Bachmat, Tao Kai Lam and Ruben Michel
Serial No.: 09/541,159
Filed: March 31, 2000

E30-043 (99-202)

store data in a plurality of logical volumes, said method comprising the steps of:

- as
- A) dividing the physical disk into a plurality of fixed sized segments characterized by boundaries independently of the logical volume configuration on the physical disk drive,
 - B) determining seek times for seek operations between the segments by assigning empirically derived seek times between two segment boundaries,
 - C) accumulating statistics for each access to each logical volume during the time interval,
 - D) converting the accumulated statistics into an estimated number of seeks between each pair of logical volumes by weighting the numbers of accesses in each of different predetermined classes,
 - E) defining a seek time for each logical volume pair based upon said segment seek times by using the center locations of each logical volume to interpolate the seek times determined for seek operations between the segments, and
 - F) generating a total seek time that is the sum of the seek times for each logical volume pair obtained as a

Applicant(s): Eitan Bachmat, Tao Kai Lam and Ruben Michel
Serial No.: 09/541,159
Filed: March 31, 2000

E30-043 (99-202)

function of the estimated number of seeks and the defined seek time for the logical volume pair.

24 (Amended). A method as recited in claim 23 wherein each of said center locations is given as an offset from a segment boundary according to:

$$p = x - \lfloor x \rfloor$$

and

$$q = \lceil y \rceil - y$$

where x and y represent center line locations of logical volumes, $\lfloor x \rfloor$ and $\lceil y \rceil$ represent "floor of x " and "ceiling of y " functions for the values of x and y based upon the boundaries of the segments and p and q represent the displacements of the center line addresses for each logical volume relative to a segment boundary.

25 (Amended). A method as recited in claim 24 wherein said definition of seek time for each logical volume includes the step of generating a seek time according to:

Applicant(s): Eitan Bachmat, Tao Kai Lam and Ruben Michel
 Serial No.: 09/541,159
 Filed: March 31, 2000

E30-043 (99-202)

$$t_{i,j} = pq \text{ time}(\lfloor x \rfloor + 1, \lceil y \rceil - 1)$$

$$+ p(1-q) \text{ time}(\lfloor x \rfloor + 1, \lceil y \rceil)$$

$$+ (1-p)q \text{ time}(\lfloor x \rfloor, \lceil y \rceil - 1)$$

$$+ (1-p)(1-q) \text{ time}(\lfloor x \rfloor, \lceil y \rceil)$$

a8

where $t_{i,j}$ represents the seek time for a specific pair of logical volumes and time is the seek interval for the corresponding relationship.

27 (Amended). A method as recited in claim 26 wherein each of the boundary locations is given as an offset from a segment boundary according to:

$$p = x - \lfloor x \rfloor$$

and

$$q = \lceil y \rceil - y$$

where x and y represent center line locations of logical volumes, $\lfloor x \rfloor$ and $\lceil y \rceil$ represent "floor of x " and "ceiling of y " functions for the values of x and y based upon the boundaries of the segments and p and q represent the

a9

Applicant(s): Eitan Bachmat, Tao Kai Lam and Ruben Michel
Serial No.: 09/541,159
Filed: March 31, 2000

E30-043 (99-202)

displacements of the center line addresses for each logical volume relative to a segment boundary.

28 (Amended). A method as recited in claim 27 wherein said definition of seek time for intravolume seeks includes the step of generating a seek time according to:

a9

$$\begin{aligned} t_{i,j} = & pq \text{ time}(\lfloor x \rfloor + 1, \lceil y \rceil - 1) \\ & + p(1-q) \text{ time}(\lfloor x \rfloor + 1, \lceil y \rceil) \\ & + (1-p)q \text{ time}(\lfloor x \rfloor, \lceil y \rceil - 1) \\ & + (1-p)(1-q) \text{ time}(\lfloor x \rfloor, \lceil y \rceil) \end{aligned}$$

where $t_{i,j}$ represents the seek time for a specific pair of logical volumes and time is the seek interval for the corresponding relationship.
